

[CLEAN VERSION OF SPECIFICATION]

**Door module for vehicle door****Field of the Invention**

5 [0001] The invention relates to a door module for a  
vehicle door, which is divided in a sealed manner into  
an outer wet door chamber, facing the door shell, and  
an inner dry door chamber, with mechanical and/or  
electrical functional components that are secured in a  
10 preassembled manner on the door module in the dry door  
chamber and can be mechanically and/or electrically  
connected to door components arranged in the wet door  
chamber, the seal between the dry door chamber and the  
wet door chamber being formed by a separating sheet  
15 which is penetrated in a sealed manner by the  
connecting means of the functional components secured  
on the door module on the near side of the separating  
sheet.

20

**Background**

[0002] A first door module for a vehicle door is known  
from the publication DE 101 44 330 A1. The vehicle  
door disclosed there comprises a door shell and a door  
25 module, which for its part has a module support and a  
decorative trim fastened to the latter on the interior  
side. The module support is connected to the door  
shell in a sealed manner in such a way that the vehicle  
door is divided into an outer wet door chamber, located  
30 on the far side of the module support, and an inner dry  
door chamber, arranged on the near side of the module  
support.

[0003] Mechanical and electrical functional  
35 components, for example a door control device, are held  
on the sturdy module support and can be fitted into

corresponding counterparts of the door components, for example of an electrical window lifter, in the wet door chamber during the assembly of the door module by using connecting means that are likewise arranged on the module support. This special design of the connecting means and the assigned counterparts means that the electrical or mechanical connection takes place by simply joining the door module with the door shell in the Y direction of a customary system of X, Y, Z coordinates of a motor vehicle, that is to say by a horizontal movement transversely to the traveling direction. After the joining of the door module, generally no further measures are required for the coupling of functional and door components. In individual cases, the connection is created by the first-time actuation of the functional components.

**[0004]** A prefabricated door module of such a design considerably simplifies and shortens the assembly at the vehicle manufacturer's and meets the set requirements. Since, however, the module support serves not only for receiving (heavy) functional elements in the dry door chamber but also for forming a seal between the dry door chamber and the wet door chamber, it is on the one hand to be designed with a correspondingly thick wall for absorbing the mechanical forces. On the other hand, it must completely cover the wet door chamber, in order to ensure the required sealing effect, and consequently has a considerable surface area extent. The door module is therefore comparatively heavy. Furthermore, such rigid plate-shaped components are generally less satisfactory in their acoustic properties.

**[0005]** A further door module is described in German Utility Model DE 296 07 664 U1. In the case of this

vehicle door too, an assembly support of a rigid design serves in the same way for separating the wet door chamber and the dry door chamber and for securing functional elements which are arranged in trough-like  
5 depressions of the assembly support. In the case of this configuration, however, the electrical drive of a window lifter is arranged in the dry door chamber, so that only the mechanical scissors-type mechanism of the window lifter that is sensitive to moisture is  
10 accommodated in the dry door chamber. The connection between the electrical drive and the scissors-type mechanism takes place in a way not described in any more detail by means of a Bowden cable.

15 **[0006]** This door module has the same disadvantages as the prior art described at the beginning, without however being provided with the advantage of simplified assembly. With the door module having a wide variety of designs, the trough-like depressions provided for  
20 receiving the functional elements also have to be shaped for all conceivable equipment variations, whereby the weight of the door module is once again increased.

25 **[0007]** A door module of the generic type is disclosed in the publication WO 03/031233 A1. In the case of this door module, the separation between the dry region and the wet region is effected by a sheet of plastic, which is arranged between the metal structure of the  
30 vehicle door and the interior trim part. The sealing with respect to the metal structure takes place by means of a sealing bead, for example a foamed sealing cord, which may, if appropriate, be provided with a special surface coating in order to counteract  
35 penetration of moisture by capillary action. The sheet of plastic is for its part connected to the outwardly

directed side of the interior trim part by adhesive bonding and is penetrated in a sealed manner by functional components arranged in the dry door chamber.

5   **[0008]** This design achieves an advantageous separation of the "supporting components" function and the "sealing or acoustics" function. The comparatively large surface area of the wet door chamber on the interior side is consequently covered over only by the  
10 thin-walled, and consequently lightweight, separating sheet.

#### **Summary**

15   **[0009]** The invention is based on the problem of further developing the door module of the generic type in such a way that its assembly and the sealing between the wet and dry door chambers is further simplified.

20   **[0010]** The problem is solved according to the invention in the case of such a door module by the interior decorative trim and/or a reinforcing element arranged on it having contact pressure zones which preferably extend over the whole periphery of the door  
25 module and onto which the separating sheet can be pressed in a sealing manner by contact with the door shell.

30   **[0011]** With a corresponding design of the separating sheet and contact pressure zone, this procedure can make additional sealing with plastic sealing compounds or peripheral sealing profiles superfluous, or at least simpler.

5     **[0012]** As in the last-mentioned prior art, the term separating sheet in principle includes all thin-walled, flexible or pliable sheet-like bodies, which may, if appropriate, also have a three-dimensionally shaped structure.

10     **[0013]** According to a first configuration of the invention, the functional components and/or the connecting means are at least partly arranged directly on the flat side of an interior decorative trim of the door module that is facing the dry chamber. Alternatively or in addition, they may also be arranged on one or more reinforcing elements, which for their part can be connected to the interior decorative trim of the door module. Such reinforcing elements are generally required in any case for stiffening the interior decorative trim, and to this extent do not increase the weight of the door module.

20     **[0014]** As already known from the prior art cited at the beginning, the door module can preferably be engaged in a latching manner with the door shell in the Y direction while forming the mechanical and/or electrical connection between the functional components and the door components. This design makes it possible for the door module and the door shell to be joined in a particularly efficient and reliable way.

30     **[0015]** According to a special configuration of the invention, the separating sheet is preassembled on the door module and can be fitted together with the latter on the door shell. In this way, the encapsulation of the entire dry door chamber takes place at the supplier's, while the vehicle manufacturer, after inserting the door components in the door shell, only has to place the door module provided with the

separating sheet onto the metal structure of the vehicle door.

[0016] A contact pressure zone suitable for carrying  
5 out the invention may comprise, for example, rib-like  
projections extending outward, that is to say in the  
direction of the separating sheet, from the interior  
decorative trim and/or the reinforcing element, on the  
end face of which the separating sheet is pressed after  
10 assembly. When there are particularly high  
requirements for the sealing effect, the contact  
pressure zone may also have two ribs spaced apart from  
each other, onto which the separating sheet is pressed  
while a sealant is introduced into the spacing between  
15 the ribs. In this case, the sealants may be arranged,  
for example, on the far side of the ribs on the  
separating sheet and be able to be brought into contact  
with the inner door panel during the assembly of the  
door module. The sealants preferably comprise a bead  
20 of sealant, which, if appropriate, can be applied  
automatically and, before the assembly of the door  
module, can be covered with a peel-off protective film.

A seal that is already adequate without additional  
sealants can be achieved with a separating sheet which  
25 comprises at least one layer of a closed-cell, and  
consequently waterproof, plastic foam, in particular of  
a polyolefin, preferably of polyethylene. Such a sheet  
may have, for example, a thickness of from 3 to 6 mm  
with an apparent density of from 30 to 60 kg/m<sup>3</sup>, which  
30 is locally compressed during assembly to approximately  
25 to 50% of its original thickness.

[0017] In a special design, the separating sheet may  
also be formed with at least two layers to improve the  
35 acoustic properties, the layer facing the dry door

chamber consisting of an open-cell plastic foam, in particular of a polyolefin, preferably of polyethylene.

[0018] In the case of a particularly preferred door  
5 module according to the invention, at least one of the  
functional elements in the dry door chamber is formed  
as an electrical drive (motor/gear mechanism) of a  
window lifter, preferably including an (electronic)  
control system and an operating device, which is  
10 fastened to the decorative trim part and/or a  
reinforcing element connected to the latter and the  
driven shaft of which penetrates through the separating  
sheet in the Y direction in a sealed manner but  
rotatably. The alignment of the driven shaft, provided  
15 for example with external toothing, allows it to be  
inserted during assembly into a counterpart of the  
mechanical part of the window lifter that is provided  
with internal toothing. Conical regions on the driven  
shaft and/or the counterpart facilitate here the self-  
20 finding of the torque-transmitting connection.

[0019] The invention also relates to a vehicle door  
with such a door module in which the inner door panel  
of the door shell preferably has a large-area cutout  
25 extending over a significant part of the inner door  
panel. Such a cutout on the one hand facilitates the  
installation of the door components and on the other  
hand reduces the weight of the vehicle door. In this  
case, the surface area of the cutout is advantageously  
30 at least 50%, preferably approximately 70%, of the  
region of the inner door panel that is covered by the  
door module. The installation of the sometimes bulky  
door components is of course facilitated by the cutout  
being free from struts running in its cross section.

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**Brief Description of the Figures**

[0020] The figures represent various configurations of the invention schematically and by way of example.  
5 In the figures:

[0021] Figure 1 shows a view from the interior side of a vehicle door equipped according to the invention;

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[0022] Figure 2 shows the view from the wet chamber side of the door module prepared for assembly on the door shell;

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[0023] Figure 3 shows the door module according to claim 2 after removal of the separating sheet;

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[0024] Figure 4 shows the view of an isolated reinforcing element;

[0025] Figure 5 shows a view of the inner door panel of the vehicle door with the door module removed;

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[0026] Figure 6 shows the section X-X through the vehicle door as shown in Figure 1;

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[0027] Figure 7 shows an enlarged view of a first connection between the inner door panel and a door module according to the invention;

[0028] Figure 8 shows an alternatively configured connection;



[0029] Figure 9 shows a third connection situation designed according to the invention;

5 [0030] Figure 10 shows a possible design of connecting means for connecting the electrical drive and mechanics of a window lifter before assembly;

[0031] Figure 11 shows the connecting means as shown in Figure 10 in the joined state.

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### Detailed Description

15 [0032] The left-hand vehicle door represented in Figure 1 comprises a door shell 1, which is usually produced from steel sheet and is provided on its side facing the interior of the vehicle with a door module 2. In the view as shown in Figure 1 there can be seen of the door module the interior decorative trim 3 on the interior side and a number of functional elements  
20 arranged in the door module 2, namely a door opener 4, a loudspeaker 5, a switch plate 6 with switch units 7 and a door locking knob 8 in a knob plate 9.

25 [0033] The door shell 1 for its part has door components, of which the door catch 10, which can be actuated by the door opener 4, can be seen in Figure 1. A cable line 11, which can be connected to the body of the vehicle, serves for the transmission of energy and information from the vehicle into the vehicle door.

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[0034] Figure 1 also shows the customary system of X, Y, Z coordinates of a motor vehicle. The references to a Y orientation in the assembly apply analogously to the right-hand door in the (-Y) direction.

[0035] As can be seen from Figure 2, the trough-like door module 2 is closed on its outwardly facing side by means of a separating sheet 12. The separating sheet 12 is penetrated on the one hand by latching hooks 13, which are arranged in a U-shaped manner peripherally around the interior decorative trim part 3 and face the door shell 1, and on the other hand by connecting means for the mechanical and electrical connection of the functional elements that are located in the door module 2 to the door components that are arranged in the shell part. The connecting means include the driven shaft 14 for the electrical actuation of a window lifter, the Bowden cable 15, which connects the door opener 4 to the door catch 10, and also a plug-in connection 16 for the data and energy transmission between the cable line 11 and the door module 2.

[0036] The separating sheet 12 also has apertures in the region of screwed joints 17, which serve for the mechanical connection of a handle 18 on the interior side (Figure 1) and the door opener 4 to the door shell 1 or door components arranged therein.

[0037] Although both the Bowden cable 15 and the driven shaft 14 must move in relation to the separating sheet 12, the related apertures, like the apertures of the screwed joints 17 and latching hooks 13, must be of a waterproof design, as still to be described below. Serving in this case for sealing the Bowden cable 15 is a bellows 19 formed onto the separating sheet 12.

[0038] In the production stage shown in Figure 2, the door module 2 is passed on by the supplier to the vehicle manufacturer and prepared by the latter on the final assembly line of the vehicle.

[0039] As represented in Figure 3, the dry door chamber formed between the separating sheet 12 and the interior decorative trim 3 receives the reinforcing element 20, which is connected to the interior decorative trim 3, and also functional elements which are anchored directly on the interior decorative trim 3 or on the reinforcing element 20, of which the electrical drive 21 (motor/gear-mechanism unit) for the window lifter and the door control unit 22 become visible only when the separating sheet is removed. From the latter there extends a further cable line 23 to the electrically adjustable and/or heatable exterior mirror 24 (see Figure 1) of the vehicle door.

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[0040] The reinforcing element 20 is provided with a rib structure 25, which can be seen in Figures 3 and 4, is assembled in the manner of a block and serves for improving accident protection in the event of side impact. The reinforcing element 20, preferably configured as an injection-molded part of glass-fiber reinforced polypropylene (PP-GF), can be formed in a geometrically very complex manner. It is therefore envisaged to form integrally on the reinforcing element 20 not only the rib structure 25 but also the cup-like receptacle 26 for the loudspeaker 5, the inner door shell 27, a door opener frame 28, the housing 29 for the plug-in connection 16 and the door control unit 22 as well as assembly bridges 30, 31 for the electrical drive 21 and the switch plate 6.

[0041] The metal structure of the vehicle door shown in Figure 5 comprises the door shell 1 with an outer door panel 32 and an inner door panel 33, which is provided with a generous cutout 34. The inner door panel 33, surrounding the cutout 34, forms a sealing

flange 35 with clip openings 36, into which the latching hooks 13 of the door module 2 can be inserted in the Y direction. Following this assembly, the separating sheet 12 lies in a sealing manner against the sealing flange 35, preferably in direct contact, that is without interposed sealing profiles.

[0042] Arranged between the inner door panel 33 and the outer door panel 32 are door components, for example the mechanism 37 of the window lifter and the guiding rails 38 for the vertically displaceable side window 39, which can be assembled without any problem in the wet door chamber 44 through the generously dimensioned cutout 34. The mechanism 37 has with respect to the driven shaft 14 of the electrical drive 21, arranged on the trim side, a counterpart 40, into which the drive shaft 14 can be pushed in the Y direction, preferably in a self-finding manner, during the assembly of the door module. Congruent toothing of the driven shaft 14 and counterpart 40, running axially parallel, permits the transmission of the torque without opposing pushing-in. Furthermore, the plug-in connection 16 is in this case fitted into a further counterpart 41. The Bowden cable 15 must previously be manually coupled to the door catch 10.

[0043] In the longitudinal section shown in Figure 6, the construction of the assembled vehicle door can be seen in detail. Special attention should be paid to the transitions 42, formed as contact pressure zones, between the interior decorative trim 3, the separating sheet 12 and the inner door panel 33, which are decisive for the sealing between the dry door chamber 43 and the wet door chamber 44.

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[0044] Horizontally outwardly extending latching hooks 13 in the form of clips 45 arranged peripherally on the interior decorative trim 3 have the effect after their insertion in the clip openings 36 on the door side of creating a pressing force acting in the Y direction between the interior decorative trim 3 and the inner door panel 33, which is transmitted via the interposed, closed-cell foamed separating sheet 12. A rib-like projection 46 formed onto the interior decorative trim and extending outward (Y direction) in a peripheral manner in the region of the sealing flange 35 of the inner door panel, has the effect that the pressing force is introduced linearly into the separating sheet 12, a high exerted pressure being created locally, with a correspondingly great sealing effect. The clips 45 are arranged outside the rib-like projection 46, and consequently also outside the dry door chamber 43.

[0045] Figure 7 shows a further design of the transition 42, in which two radially spaced apart rib-like projections 46.1, 46.2 are arranged peripherally on the interior decorative trim 3. The sealant 47 in the form of a plastically deformable bead of sealant 48, which before assembly can be covered with a peel-off protective film, is applied to the side of the separating sheet 12 facing the sealing flange 35 in the spacing between the rib-like projections 46.1, 46.2. After the removal of the protective film and assembly of the door module 2, the bead of sealant 48 can be brought into contact with the inner door panel 33.

[0046] Represented in Figure 8 is an alternative configuration of the transition 42, in which the clips 45 are arranged on the near side of the rib-shaped projections 46.1, 46.2, that is to say within the dry door chamber 43, and therefore have to be separately

sealed. For this purpose, the clips 45 are provided in the head region with a peripheral, convexly curved sealing collar 49, which presses the separating sheet 12 onto the sealing flange 35 along a circular line.

5 In this exemplary embodiment, the separating sheet 12 is of a two-layered construction, the layer 50.1 facing the wet door chamber 44 being of a closed-cell form, and consequently waterproof, whereas the layer 50.2 facing the dry door chamber is of an open-cell form,

10 and consequently acoustically active. On the head side, the clips 45 are let into a reinforcing element 20, which for its part is welded to the interior decorative trim 3. The sealing flange 35 of the inner door panel 33 is provided in the spacing between the

15 rib-like projections 46.1, 46.2 with a protuberance 51.1, which is directed inward, that is to say in the direction of the interior decorative trim, and by which the sealing is improved while dispensing with sealant 47. By contrast, if a bead of sealant 48 is inserted

20 (Figure 7), the inner door panel can be provided with a protuberance 51.2 facing the wet door chamber, in order to create the space for the bead of sealant 48 between the separating sheet 12 and the sealing flange 35.

25 **[0047]** The exemplary embodiment as shown in Figure 9 departs from the designs previously described to the extent that both the rib-like projections 46 (in this case two pairs 46.1/46.2 and 46.3/46.4, which enclose the clip 45) and the receptacle for the clip 45 are

30 arranged on the reinforcing element 20.

**[0048]** In the last figures, the connection between the electrical drive 21 and the mechanism 37 of the window lifter is represented before (Figure 10) and after

35 (Figure 11) the assembly of the door module 2.

[0049] The electrical drive 21 comprises an electric motor 52 with a rotor mounted orthogonally in relation to the Y direction and an angular gear mechanism 53 with an driven shaft 14, which runs in the Y direction, is conically tapered at the end and has external tothing, which is mounted in a sealed manner in the angular gear mechanism 53. The housing 54 of the angular gear mechanism 53 is provided on its side facing the wet door chamber 44 with annularly peripheral projections 55, by which the separating sheet 12 lying in between (if appropriate with insertion of a further bead of sealant 48.1) can be pressed against the metal structure of the mechanism 37. The mechanism 37 for its part comprises the counterpart 40 with internal tothing, which is non-rotatably connected to the cable reel 57 of the window lifter.

[0050] During the assembly of the door module, the driven shaft 14, protruding beyond all the other components (for example the clips 45) takes on special significance, since it represents the primary, relatively easy-to-find, positioning point for the alignment of the door module. Only once the driven shaft 14 has been pushed a little further into the counterpart 40 is a centering of the clips 45 and of the clip openings 36 as well as of the other connecting elements (for example plug-in connection 16) brought about by turning of the door module 2.

[0051] If, on the other hand, a different positioning point is provided for the assembly, it is recommendable to mount the driven shaft 14 or the counterpart 40 such that it is floating in the X and Z directions, in order to avoid distortion.

**List of designations**

- |       |                          |
|-------|--------------------------|
| 1     | door shell               |
| 2     | door module              |
| 3     | interior decorative trim |
| 4     | door opener              |
| 5     | loudspeaker              |
| 6     | switch plate             |
| 7     | switch unit              |
| 8     | door locking knob        |
| 9     | knob plate               |
| 10    | door catch               |
| 11    | cable line               |
| 12    | separating sheet         |
| 13    | latching hook            |
| 14    | driven shaft             |
| 15    | Bowden cable             |
| 16    | plug-in connection       |
| 17    | screwed joint            |
| 18    | handle                   |
| 19    | bellows                  |
| 20    | reinforcing element      |
| 21    | electrical drive         |
| 22    | door control unit        |
| 23    | cable line               |
| 24    | exterior mirror          |
| 25    | rib structure            |
| 26    | receptacle               |
| 27    | inner door shell         |
| 28    | door opener frame        |
| 29    | housing                  |
| 30,31 | assembly bridge          |
| 32    | outer door panel         |
| 33    | inner door panel         |
| 34    | cutout                   |
| 35    | sealing flange           |
| 36    | clip openings            |



37	mechanism (of the window lifter)
38	guiding rails
39	side window
40, 41	counterpart
42	transition
43	dry door chamber
44	wet door chamber
45	clip
46	rib-like projection
47	sealant
48	bead of sealant
49	sealing collar
50	layer
51	protuberance
52	electric motor
53	angular gear mechanism
54	housing
55	projection
56	metal structure
57	cable reel